AMENDMENTS TO THE CLAIMS

1-39 (canceled).

40. (New) A method of forming a bioactive coating on a metallic biomedical implant, the method including the step of exposing at least part of the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species, wherein the vapour pressure of the hydroxylating oxidant species in the plasma gas is varied over time during exposure of the implant to thereby form a graded bioactive coating on said part of the substrate surface.

41. (New) A method as in claim 40, wherein the reactive hydroxylating oxidant species that is included in the plasma gas is formed using an agent selected from the list consisting of hydrogen peroxide, water, oxygen/water and air/water.

42. (New) A method as in claim 41, wherein the agent that is used to form the reactive hydroxylating oxidant species in the plasma gas is hydrogen peroxide.

43. (New) A method as in claim 40, wherein the vapour pressure of the hydroxylating oxidant species in the plasma gas is increased over time during exposure of the implant.

44. (New) A method as in claim 40, wherein the implant is made from stainless steel, titanium, titanium alloy, or cobalt-chromium.

45. (New) A method as in claim 40, further including a step of forming a hydroxyapatite layer on the graded bioactive coating *in vitro* prior to implantation.

46. (New) A method as in claim 40, wherein the step of exposing at least part of the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species is preceded by a step of exposing the implant to a plasma gas formed from air or oxygen and an organosilane or organosilicate species to form a silica coating on at least part of the implant prior to contact with the oxidant species, wherein a ratio of organosilane or organosilicate to air or oxygen in the plasma gas is varied over time to deposit a graded composite silica coating.

47. (New) A method as in claim 46, wherein the ratio of organosilane or organosilicate to air or oxygen in the plasma gas is increased over time to deposit a graded composite silica coating.

48. (New) A method as in claim 46, wherein the organosilane is a tetralkylorganosilane containing alkyl groups having between 1 and 5 carbon atoms.

49. (New) A method as in claim 48, wherein the organosilane is tetraethoxysilane.

50. (New) A method as in claim 46, wherein the coating is a Type II silica coating.

51. (New) A method as in claim 46, wherein the graded composite silica coating is deposited at a pressure of about 5×10^{-1} Torr, a power level of 40 W to 100 W, and a source of organosilane or organosilicate at about 8°C.

52. (New) A method as in claim 51, wherein the temperature of the source of organosilane or organosilicate is varied over time whilst maintaining the flow rate of air or oxygen relatively constant.

53. (New) A method as in claim 46, wherein the steps of exposing the implant to a plasma gas formed from air or oxygen and an organosilane or organosilicate species and exposing the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species and are carried out in a continuous manner in a plasma chamber.

54. (New) A method as in claim 46, further including a step of forming a hydroxyapatite layer on the graded composite silica coating *in vitro* prior to implantation.

55. (New) A biomedical implant having a bioactive coating that is formed using the method of claim 40.

56. (New) A biomedical implant having a bioactive coating that is formed using the method of claim 46.

57. (New) A bioactive biomedical implant as in claim 56, wherein the implant has a hydroxylated, graded composite silica coating having an average thickness of less than 300 nm.

58. (New) A bioactive biomedical implant as in claim 57, wherein the implant has a hydroxylated, graded composite silica coating having an average thickness of less than 200 nm.

59. (New) A bioactive biomedical implant as in claim 58, wherein the implant has a hydroxylated, graded composite silica coating having an average thickness of less than 100 nm.

60. (New) A method of improving the fixation of an implanted metallic biomedical implant, the method including the step of exposing at least part of the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species, wherein the vapour pressure of the hydroxylating oxidant species in the plasma gas is varied over time during exposure of the implant to thereby form a graded bioactive coating on said part of the substrate surface.

61. (New) A method as in claim 60, wherein the reactive hydroxylating oxidant species that is included in the plasma gas is formed using an agent selected from the list consisting of hydrogen peroxide, water, oxygen/water and air/water.

62. (New) A method as in claim 61, wherein the agent that is used to form the reactive hydroxylating oxidant species in the plasma gas is hydrogen peroxide.

63. (New) A method as in claim 60, wherein the vapour pressure of the hydroxylating oxidant species in the plasma gas is increased over time during exposure of the implant.

64. (New) A method as in claim 60, wherein the implant is made from stainless steel, titanium, titanium alloy, or cobalt-chromium.

65. (New) A method as in claim 60, further including a step of forming a hydroxyapatite layer on the graded bioactive coating *in vitro* prior to implantation.

66. (New) A method as in claim 60, wherein the step of exposing at least part of the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species is preceded by a step of exposing the implant to a plasma gas formed from air or oxygen and an organosilane or organosilicate species to form a silica coating on at least part of the implant prior to contact with the oxidant species, wherein a ratio of organosilane or organosilicate to air or oxygen in the plasma gas is varied over time to deposit a graded composite silica coating.

67. (New) A method as in claim 66, wherein the ratio of organosilane or organosilicate to air or oxygen in the plasma gas is increased over time to deposit a graded composite silica coating.

68. (New) A method as in claim 66, wherein the organosilane is a tetralkylorganosilane containing alkyl groups having between 1 and 5 carbon atoms.

69. (New) A method as in claim 68, wherein the organosilane is tetraethoxysilane.

70. (New) A method as in claim 66, wherein the coating is a Type II silica coating.

71. (New) A method as in claim 66, wherein the graded composite silica coating is deposited at a pressure of about 5×10^{-1} Torr, a power level of 40 W to 100 W, and a source of organosilane or organosilicate at about 8°C.

72. (New) A method as in claim 66, wherein the temperature of the source of organosilane or organosilicate is varied over time whilst maintaining the flow rate of air or oxygen relatively constant.

73. (New) A method as in claim 66, wherein the steps of exposing the implant to a plasma gas formed from air or oxygen and an organosilane or organosilicate species and exposing the surface of the implant prior to implantation with a plasma gas containing a reactive hydroxylating oxidant species and are carried out in a continuous manner in a plasma chamber.

74. (New) A method as in claim 66, further including a step of forming a hydroxyapatite layer on the graded composite silica coating *in vitro* prior to implantation.

75. (New) A method of hydroxylating a surface of a biomedical implant, the method including the step of exposing the surface of the implant with a plasma gas formed using hydrogen peroxide, wherein the surface concentration of hydroxyl groups on the surface of the implant is about three times the surface hydroxyl group concentration that is formed using methods other than hydrogen peroxide plasma treatment.

76. (New) A biomedical implant formed using the method of claim 75.